1. a. $M_B = -21.51$

$$R_{25} = 10^{(-0.249(-21.51)-4)} = 22.7 \text{ kpc}$$

b. $$V_{max} = 10^{\frac{3.31 - M_B}{11.0}} = 10^{\frac{3.31+21.51}{11.0}} = 180 \text{ km/s}$$

c. $$\omega = \frac{V}{R} = \frac{180 \text{ km/s}}{(22.7\times10^3 \text{ pc})\left(\frac{3.09\times10^{13} \text{ km}}{\text{pc}}\right)} = 2.566\times10^{-16} \frac{\text{rad}}{\text{s}}$$

$$\omega = 2.566\times10^{-16} \frac{\text{rad}}{\text{s}}\left(\frac{3.16\times10^7 \text{ s}}{\text{yr}}\right)\left(\frac{3600''}{1^\circ}\frac{360^\circ}{2\pi \text{ rad}}\right) = 1.67\times10^{-3} \frac{\text{arcsec}}{\text{yr}}$$

d. 598 yrs I'm going to guess he didn't live long enough to measure this.

2. a. $$M_{virial} \approx \frac{5R\sigma_r^2}{G} = \frac{5(3.7\text{pc}\cdot\frac{3.09\times10^{16}\text{ m}}{\text{pc}})(\frac{1.00}{3.75}\times10^5 \text{ m/s})^2}{6.67\times10^{-11}\frac{\text{N m}^2}{\text{kg}^2}}$$

$$= 8.60\times10^{37} \text{ kg} = 4.31\times10^7 M_\odot$$

b. $$M = \frac{V_{max}^2 R}{G} = \frac{(2.00\times10^5 \text{ m/s})^2(3.7\text{pc}\cdot\frac{3.09\times10^{16}\text{ m}}{\text{pc}})}{6.67\times10^{-11}\frac{\text{Nm}^2}{\text{kg}^2}}$$

$$= 686\times10^{37} \text{ kg} = 3.45\times10^7 M_\odot$$